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ABSTRACT

The impact of age effects on nonverbal memory for auditory or tactual patterns has been largely neglected in research studies. The effects of age on nonverbal memory were investigated by comparing subjects (N=120), divided by age decades into six groups (N=20), through tests using visual, auditory, and tactual items which were resistant to verbal labeling. Test scores for tasks in all three modalities were progressively lower with increases in age. In young groups, auditory and tactual recognition showed a slight, insignificant increase: in the older groups, the modality pattern was reversed. Results indicate that nonverbal memory through all three modalities is adversely affected by age, but the rate of impairment varies considerably with sensory modality. (Author/NRB)

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MODALITY AND AGE COMPARISONS IN NONVERBAL MEMORY

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Modality and Age Comparisons in Nonverbal Memory

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Few would deny that pictures are better remembered than their verbal labels. But there is also the contention that nonverbal memory, usually taken to be memory for pictures or geometric designs, declines more rapidly with age than memory for verbal information. Reports of age differences in nonverbal memory are not yet conclusive. Some report an age deficit in reproducing or recognizing from memory visual designs; other find the old as proficient as the young. Few studies tested other than the visual modality. Investigation of age effects upon nonverbal memory for auditory or tactual patterns has been largely neglected.

Memory and modality are interrelated, but it is not yet sufficiently known whether sensory modalities rely upon different processing systems. At present it is held that information is processed by the modality which is most suited, but evidence for this is based almost exclusively upon verbal items. Other studies argue for central processing.

Using this central information processing approach we would hypothesize that memory through visual, auditory, and tactual modes would be affected by age at similar rates. In this study nonverbal memory was tested in all three modalities. To compare age differences in each, recognition tasks with similar design, length, and response mode were used. Measures derived from Theory of Signal Detection (TSD) were used to provide estimates of discriminability (d').

METHOD

In the present experiments, performances of 120 healthy volunteers, divided by age decades into six groups (N = 20), were compared in tests using visual, auditory, and tactual items which were resistant to verbal labeling.

Items for the visual recurrent recognition task were geometric art patterns (Victor Vasarely, France) reproduced in color on slides with permission by the artist; they were presented tachistoscopically for 0.5 sec each separated by a 7.5 sec interval. Ten of these were selected as target items and were presented once in the study phase. In the test phase, initiated 1 min later, a person was asked to recognize (Yes, No) the target items which recurred twice, intermingled in a 40-item series with distractors.

Items for the nonverbal auditory task were 3-sec sections of bird calls reproduced on tape from authentic recordings of South and North American birds. Any commonly recognizable bird call was excluded as determined by seven raters. The bird calls were presented through headphones, each followed by a 5 sec interval. Eight bird calls were selected as target items which were to be recognized twice in a 32 item test series.

Items for the nonverbal tactual test consisted of wire shapes made from coathanger wire into hand-sized, flat, curved figures, modified after Kimura's (1966) Random Visual Figures. Four of these were used in the study phase, two for left-hand recognition, two for right-hand recognition. These were presented twice for active touch for 15 sec each. A person performed blindfolded with "Yes" or "No" responses to successive probe figures. In the recognition test, the four target figures recurred three times each, intermingled in random order with 12 different distractor figures.

Results and Discussion

The signal detection measures d' for the visual, auditory, and tactual recognition performances were negatively correlated with age. That is, test scores for all three tasks were progressively lower with increase in age. In the 7th and 8th decade of life, in particular, nonverbal recognition becomes more difficult.

Figure 1 Here

This result was expected and conforms to a similar age deficit observed in memory for visual designs by Arenberg and others.

Age differences in nonverbal memory may be interpreted as differences among the young and the old in solving perceptual problems. To evaluate this, Block Design measures of the WAIS were obtained and the variance shared with age was partialled out as the increment in R^2, and a conservative estimate of the "added" contribution of age was obtained. Block Design accounted for part of the test score differences; nevertheless, age significantly predicted performance on the modality-specific recognition tests over and above the predictability from Block Design.

The overall differences among age groups were further examined in step-down analysis. In this, tests were entered into univariate analyses of covariance. After its variance effect was determined, each test served as a covariate for tests examined in subsequent steps. The age effect was robust. Even after adjustment for performances on Block Design or Visual tests, age groups differed in auditory and tactual performances. Much of the age difference was located between persons of the 60-84 year groups and younger persons 20-39 years old, as seen in the drop from d' $\sim$ 3.0 to d' $\sim$ 1.5 in the auditory and tactual scores.

However, the decreases in d' measures across age were not the same for the visual, auditory, or tactual modality. Although the memory and attention demands in each task were comparable, persons in this study did not perform equally proficient, in particular, on the tactual task. Profile analyses indicated that the six age groups had dissimilar performance profiles on the three tasks [$F(2,114) = 19.56$, $p < 0.001$] and the recognition of visual or auditory patterns was not parallel to that of tactual patterns.

Although all three modalities had progressively lower recognition d' scores across age groups, test for homogeneity of regression demonstrated that their regression lines were not parallel. The regression coefficients were significant for each modality but this did not answer our question whether the rate of cross-sectional "decline" was the same among modalities. We compared the slopes of the regression lines of the visual, auditory, and tactual modalities by evaluating the variation explained by the three modalities separately against a common R^2. In effect, we tested the increment in the proportion of variance accounted for by using separate b's for each modality against the proportion of variance explained by a common b.

Figure 2 Here

We found this increment in R^2 to be significant [$F(2,355) = 5.979$, $p < 0.001$]. In other words, beta coefficients differed among modality indicating that recognition memory did not decrease with age in the three modalities in a comparable manner. As seen in Figure 2, tactual performance showed a more rapid decrease with age than visual [$F(1,236) = 4.978$, $p < 0.05$] or auditory [$F(1,236) = 5.458$, $p < 0.05$] recognition performances.

Figure 3 Here

It is of particular interest to note the difference in pattern of age differences in the three modalities. While visual recognition remains relatively stable across the twenty to forty-nine year age range, both auditory and tactual memory show a rapid and significant drop in accuracy across this range. By comparison, in the oldest age range (60-84 years) the visual recognition accuracy is significantly diminished while auditory and tactual memory are relatively stable. This age dependent imbalance in recognition within modalities is also seen in the lack of difference in slope between auditory and tactual regression lines, whereas significant slope differences are found between these modalities and the visual regression lines only for the young 20 year span.

The origin of these rate differences between modalities seemed to be the young and the old. When age groups were tested in 20-year age spans, the modality-specific beta's differed only in the 20-39 year old [$F(2,115 = 5.079, p < 0.01$] and the 60-84 year old [$F(2,115) = 8.240, p < 0.01$]. The middle aged groups (40-59 years) did not show differences in beta among modalities.

It is puzzling to interpret these diverging decrements in recognition memory. In young groups, auditory and tactual recognition decreases rapidly whereas visual recognition shows a slight although insignificant increase; in the old this modality pattern is reversed. Why the visual memory modality is spared longer than auditory or tactual in age comparisons cannot be answered from this study. It is plausible to assume that colored visual patterns provide more coding dimensions and its mode is preferred by the middle-aged. We conclude that nonverbal memory through all three modalities is adversely affected by age but the rate of impairment varies considerably with sensory modality tested.

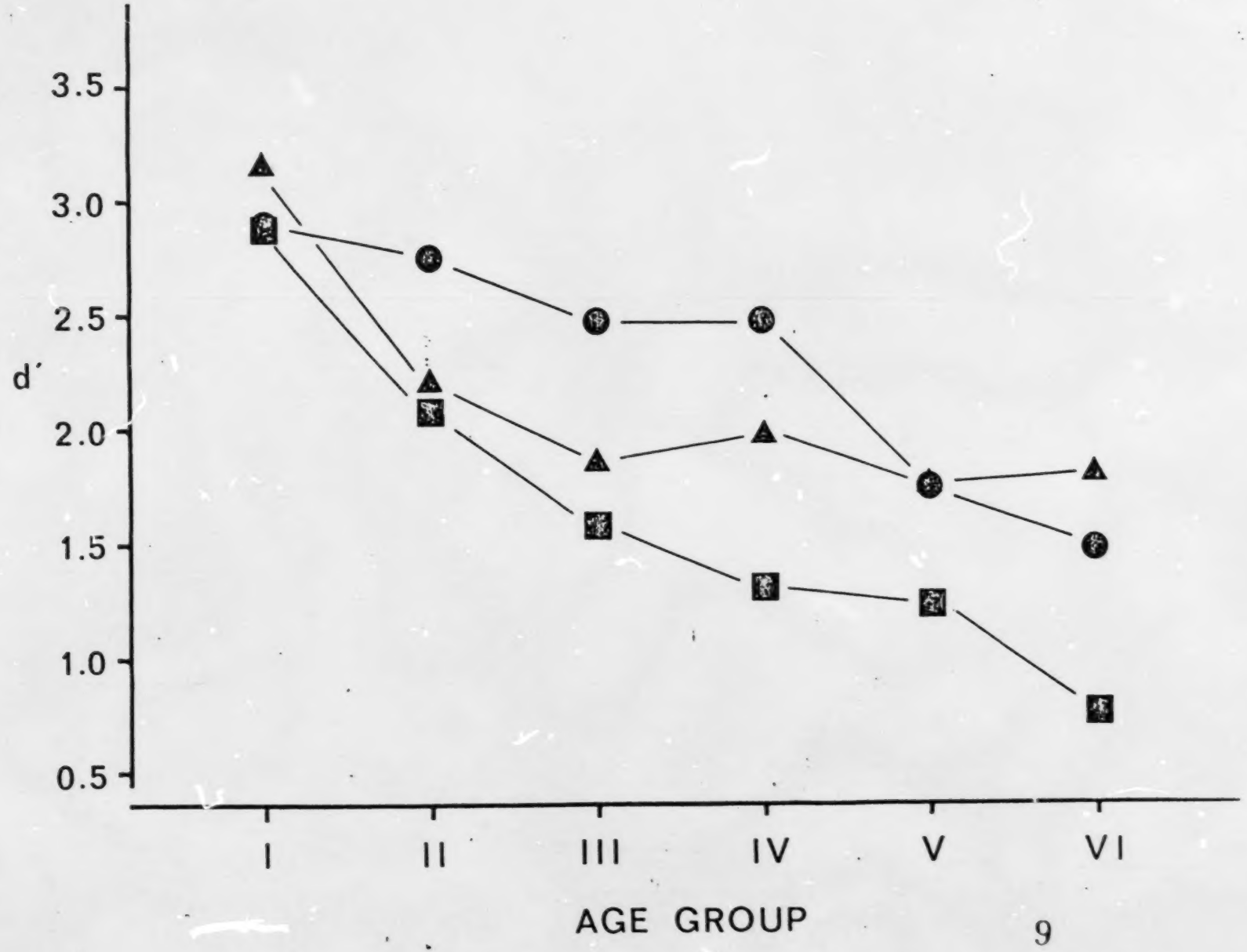

Figure 1.

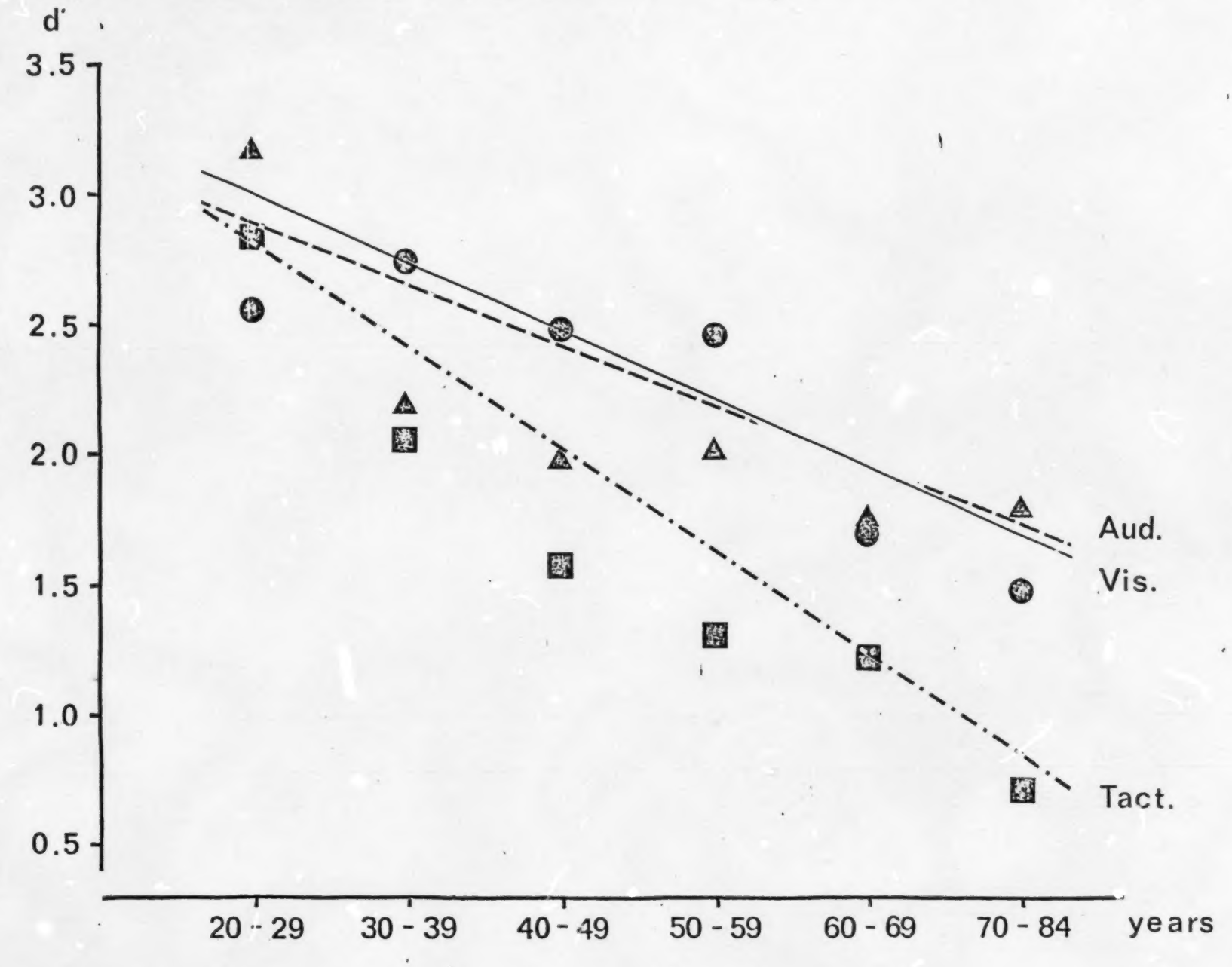
d'
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Aud.
Vis.
Tact.
20 - 29
30 - 39
40 - 49
50 - 59
60 - 69
70 - 84
years

Figure 2.

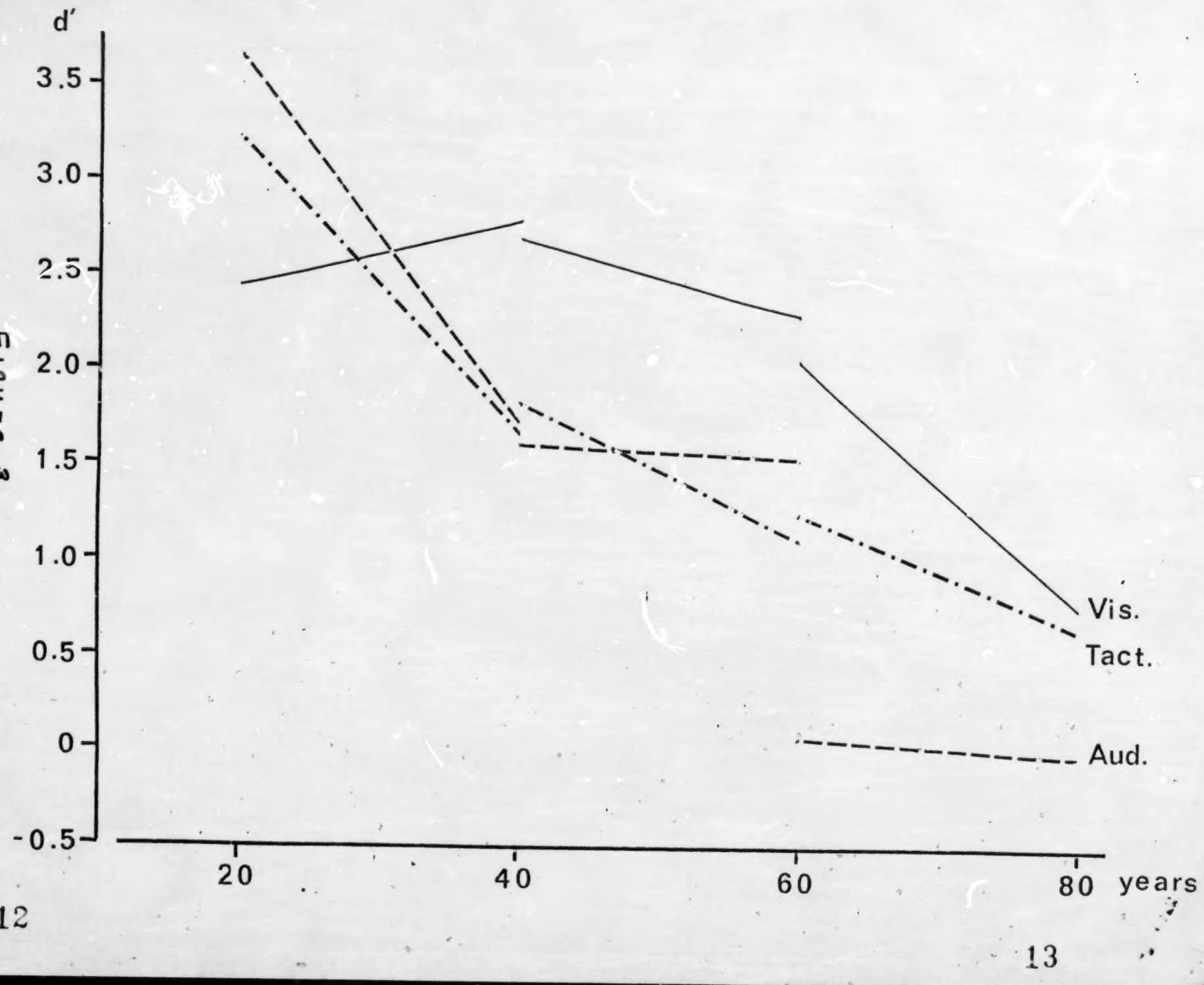

Figure 3.